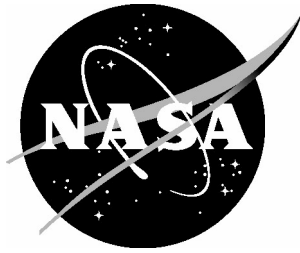


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Modular Engine Noise Component Prediction System (MCP) Program Users' Guide

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September 2004

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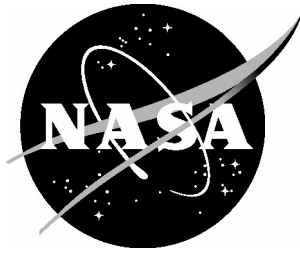
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1 Introduction

The Modular Engine Noise Component Prediction System (MCP) allows the user to generate turbofan engine noise estimates. The program is an empirical procedure that has evolved over many years at The Boeing Company. The data used to develop the procedure include both full-scale engine data and small-scale model data, and include testing done by Boeing, by the engine manufacturers, and by NASA.

The version of the program described here was developed in 2000 under NASA contract NAS1-97040, Task 10. The work done under this contract included migrating selected components modules from a Unix operating system to a Windows/PC operating system, developing a new user interface, and incorporating various updates to the prediction modules.

In order to generate a noise estimate, the user specifies the appropriate engine properties (including both geometry and performance parameters), the microphone locations, the atmospheric conditions, and certain data processing options. The program is modular, meaning that the user specifies which engine noise components will be predicted. The version of the program described here allows the user to predict three components: inlet-radiated fan noise, aft-radiated fan noise, and jet noise. These components are described in Sections 2.2, 2.3, and 2.4, respectively.

MCP predicts one-third octave band noise levels over the frequency range of 50 to 10,000 Hertz. It also calculates overall sound pressure levels and certain subjective noise metrics (e.g., perceived noise levels).

Features of the program include the ability to:

- predict either static, steady state “test stand” noise levels, or airplane flyover noise levels
- predict either polar arc microphone levels or sideline microphone levels
- predict either free-field or 4-foot pole microphone ground-reflected levels
- add deltas to selected components (e.g., to account for acoustic lining effects, installation effects, etc.,)

2 Overview of the MCP Modules

This section gives a brief overview of the MCP modules.

2.1 EXTRAP

The first module that is required to run MCP is the EXTRAP module. This module contains parameters describing the flight path, the atmospheric conditions, and certain extrapolation and propagation options.

2.2 INLET3

The INLET3 module predicts the noise associated with the fan that is radiated out of the engine inlet. This prediction module predicts three separate subcomponents, associated with different noise-generation mechanisms. These subcomponents are described in the following sections.

2.2.1 *Tone Subcomponent*

Fan noise is generated by unsteady aerodynamic loading on rigid surfaces, such as the fan blades and the stator vanes. Unsteady aerodynamic loading associated with periodic flow fluctuations results in tone noise. This can be due to a number of sources such as the interaction of an inlet wake with the rotating fan blades. The steady (when viewed from rotating reference frame) lift and drag forces on rotating fan blades result in harmonic fluctuations in the non-rotating reference frame. These fluctuations appear at the blade passing frequency and its harmonics.

2.2.2 *Broadband Subcomponent*

When the unsteady aerodynamic loading is associated with random flow fluctuations (such as turbulence) broadband noise is generated. This can be due to a number of sources such as: inflow turbulence impinging on rotor blades and stator vanes; rotor wake turbulence impinging on downstream stators; and interaction of

the blade tip flow with the turbulent wall boundary layer. In addition, there are a number of possible sources of rotor or stator broadband self-noise: turbulent boundary layers; turbulent wakes; and incoherent trailing edge vortex shedding.

The INLET3 broadband subcomponent module is based on Reference 1.

2.2.3 *Multiple Pure Tone (Buzzsaw) Subcomponent*

When the blades rotate at supersonic tip speeds, bow shocks form at their leading edges. These react non-linearly with each other as they propagate upstream through the inlet. Slight variations in shock strengths result in a pressure spectrum with discrete tones at the shaft rotational frequency and its harmonics. This noise is referred to as multiple pure tone noise, buzzsaw noise, or combination tone noise.

2.3 AFTFN7

The AFTFN7 module predicts the noise that is radiated out of the fan exhaust duct. Like the INLET3 module, this module predicts separate subcomponents, associated with different noise-generation mechanisms, although in this case there are only two subcomponents. These subcomponents are described in the following sections.

2.3.1 *Tone Subcomponent*

The source mechanisms are similar to inlet-radiated tone noise (Section 2.2.1).

2.3.2 *Broadband Subcomponent*

The source mechanisms are similar to inlet-radiated broadband noise (Section 2.2.2).

2.4 JEN6E

The JEN6E module predicts the noise generated by the jet exhaust flow. Jet exhaust noise is comprised of turbulent mixing noise, shock-associated noise, and noise generated by the interaction of the jet flow with wing surfaces. These subcomponents are described in the following sections.

2.4.1 *Turbulent Mixing Noise Subcomponents*

JEN6E models the jet mixing noise as being generated from the mixing associated with three flow streams: the primary (core or inner) flow stream; the secondary (fan or outer) flow stream; and the mixed (or merged) flow stream.

The noise in the primary jet region is generated by the turbulent mixing of the primary and secondary flows. Similarly, the noise in the secondary jet region is generated by the turbulent mixing of the secondary and the ambient flows.

The mixed jet flow stream refers to the merged primary and secondary flow streams, although there is no clear boundary defining the transition of these separate flows into a mixed flow. The noise in this region is generated by the turbulent mixing of the merged and the ambient flows.

The JEN6E turbulent mixing subcomponent modules are based on Reference 2.

2.4.2 *Shock-associated Subcomponent*

Shock-associated noise is believed to be generated by the large-scale turbulent structures in the mixing layer interacting with the quasi-periodic shock cells of an improperly expanded jet. This localized deformation of the shock wave results in the emission of sound. Unlike screech tones, this noise is broadband, although strongly peaked.

The JEN6E shock-associated noise subcomponent module is based Reference 3. , and the coding logic is taken from Reference 4.

2.4.3 *Jet/Flap Interaction*

The JEN6E module is able to calculate the acoustic effect of the jet exhaust flow interacting with airplane wing surfaces.

3 Running MCP Using the MCP Assistant

A graphical user interface has been developed for running the PC-hosted version of the Modular Engine Noise Component Prediction System (MCP). This interface is known as the MCP Assistant. The MCP Assistant aids in creating correctly formatted input files, in specifying the names and locations for the various output files that MCP generates, and in executing the program.

When the MCP Assistant program is started the “MCP Assistant Main” screen, shown in Figure 1, appears. From this screen the user can create an input file, open and edit an existing input file, read the online help documentation, or exit the program. The following sections describe how to create input files and run the program.

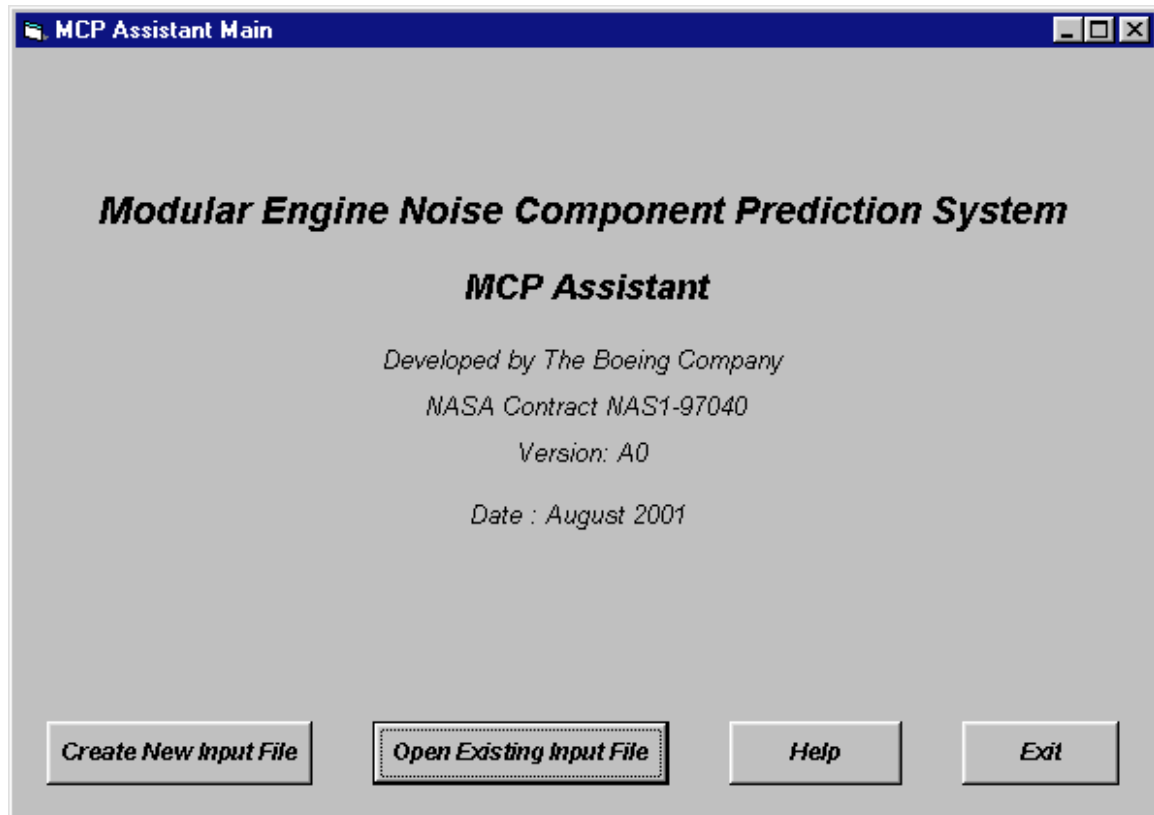


Figure 1 The “MCP Assistant Main” Screen

3.1 Creating a New Input File

Clicking on the “Create New Input File” button from the “MCP Assistant Main” screen displays the blank “File Editor” screen shown in Figure 2. On this screen are displayed a series of tabs, one for each of the various modules. For whichever tab is selected, an appropriate table is shown with the input parameters for that particular module. The parameter definitions, in the form of screen tips, can be displayed by locating the cursor over the parameter of interest as shown in the figure. This feature can be disabled by clicking the “Disable Tips” box in the lower left part of the screen.

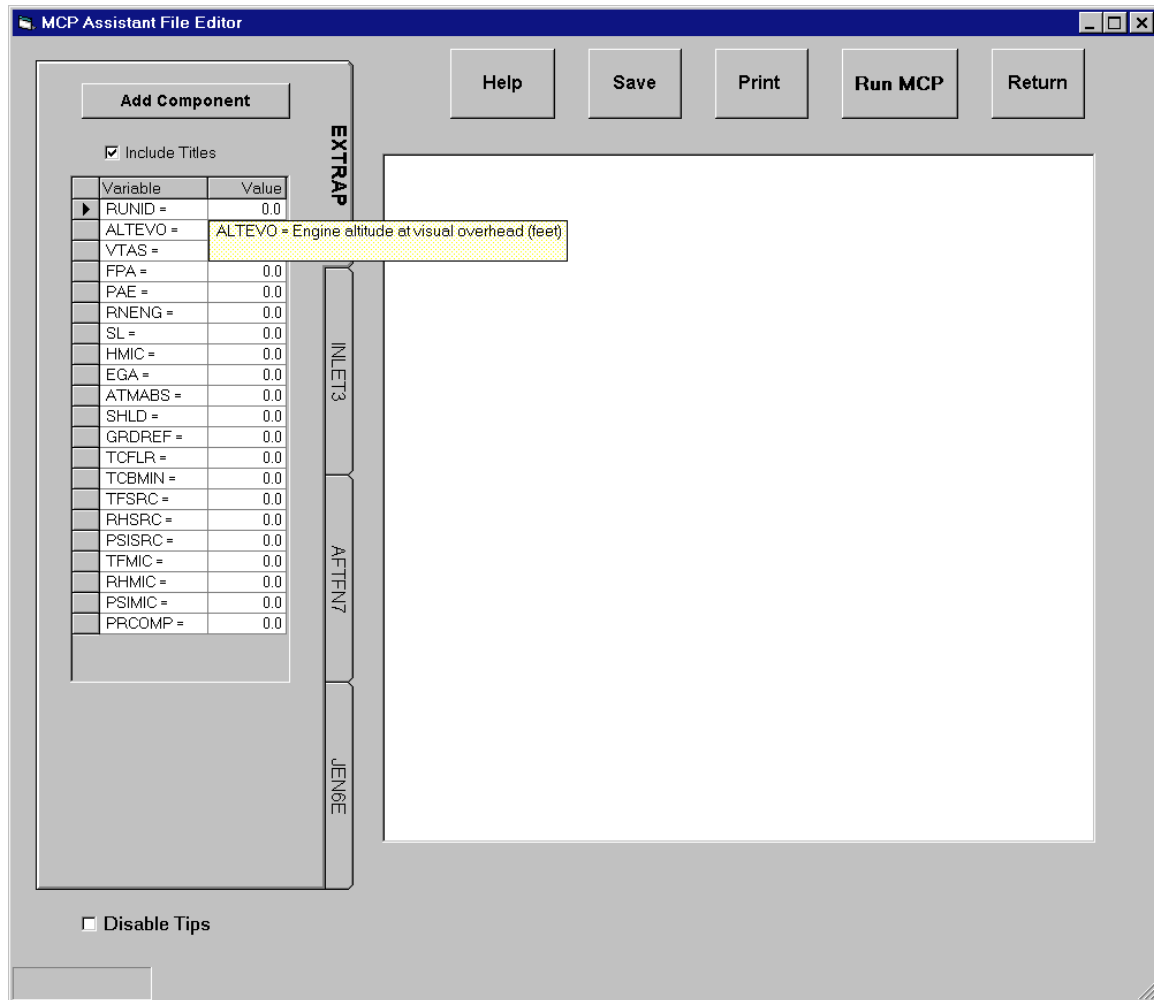


Figure 2 The MCP Assistant Blank “File Editor” Screen with Screen Tip Displayed

The user enters the parameter values in the table and clicks on the “Add Component” button when finished. When this button is clicked the module information is displayed in the main viewing area of the “File Editor” screen in the format required by MCP, as shown in Figure 3. (This format is discussed in Section 6.1, and examples are shown in Section 8.) This viewing area also functions as a full-screen editor. Note that once the module information is transferred to the main viewing area, it can no longer be edited from the table on the left-hand side of the screen, but only from the main viewing area. The user repeats the process of adding components for each of the modules desired. Note that the EXTRAP module and at least one other module is required to make a noise prediction.

MCP Assistant File Editor

Buttons: Help, Save, Print, Run MCP, Return

Add Component

☐ Include Titles

Variable	Value
RUNID =	0.0
ALTEVO =	0.0
VTAS =	0.0
FPA =	0.0
PAE =	0.0
RNENG =	0.0
SL =	0.0
HMIC =	0.0
EGA =	0.0
ATMABS =	0.0
SHLD =	0.0
GRDREF =	0.0
TCFLR =	0.0
TCBMIN =	0.0
TFSRC =	0.0
RHSRC =	0.0
PSISRC =	0.0
TFMIC =	0.0
RHMIC =	0.0
PSIMIC =	0.0
PRCOMP =	0.0

EXTRAP

INLET3

AFTFN7

JEN6E

☐ Disable Tips

```

TITLE 1 Modular Engine Noise Component Prediction System
TITLE 2 Example Run with No Deltas
TITLE 3 First Condition
TITLE 4 (up to four lines of title information allowed)
EXTRAP
-----
ALTEVO= 18.0, SL = -150, VTAS = 0.0, FPA= 0.0,
PAE = 0.0, HMIC= 0.00, RNENG= 1,
-----
EXTRAP OPTIONS
-----
RUNID = 1950, EGA = 0, ATMABS= 1, SHLD = 0,
GRDREF= 0, TCFLR= 30, TCBMIN= 17, PRCOMP= 1,
-----
WEATHER
-----
TFSRC = 77.0, RHSRC= 70.0, PSISRC=14.7,
TFMIC = 77.0, RHMIC= 70.0, PSIMIC=14.7
-----
COMPONENTS
-----
INLET3
XN1 = 2000., XN1R1 = 1950., XMTIP = 0.750,
FCHORD= 10.000, XMFF = 0.250, RLINL = 5.00,
FHTR = 0.375, FBLNO = 36, FANDIA= 90.0,
FTIPCH= 4.000, FEGV = 78, P12 = 14.675,
T1 =536.500, DBUZZ = 0.0, DIFBB = 0.0,
DIFBPF= 0.0, DI2BPF= 0.0, DI3BPF= 0.0,
DI4BPF= 0.0, NUNTON= 4
-----
AFTFN7
XN1 = 2000., XMTIP = 0.750, FANPR = 1.200,
FBLNO = 36, FANDIA= 90.0, FCHORD= 10.000,
SHLOG = 40.0, DABB = 0.0, DABPF = 0.0,
DA2BPF= 0.0, DA3BPF= 0.0, DA4BPF= 0.0,
MTNAFT= 5
-----
JEN6E
XN1 = 2000., FANDIA= 90.0, SDIST = 12.00,
AE7 = 6.50, T7 = 1125.0, VJI7 = 535.0,
AE17 = 19.00, T17 = 570.0, VJI17 = 530.0,

```

Figure 3 The MCP Assistant “File Editor” Screen with Component Parameters Shown

On the EXTRAP tab an “Include Titles” checkbox is available (Figure 2). When this box is checked the correct formatting for title information is transferred to the main viewing area. The particular titling, up to four lines, can be inserted using this editor. Note that the title lines must begin with “TITLE 1”, etc.

On the various prediction module tabs, the tables include a number of arrays that are associated with adding spectral deltas to that particular component, as shown in Figure 4. (This process is described in Sections 5.2 and 5.3.) If the user has checked the “Add Array Template” box when the “Add Component” button is clicked, a set of “dummy” array parameter values will appear in the main viewing area. These values must be edited (or deleted) in order to run the program.

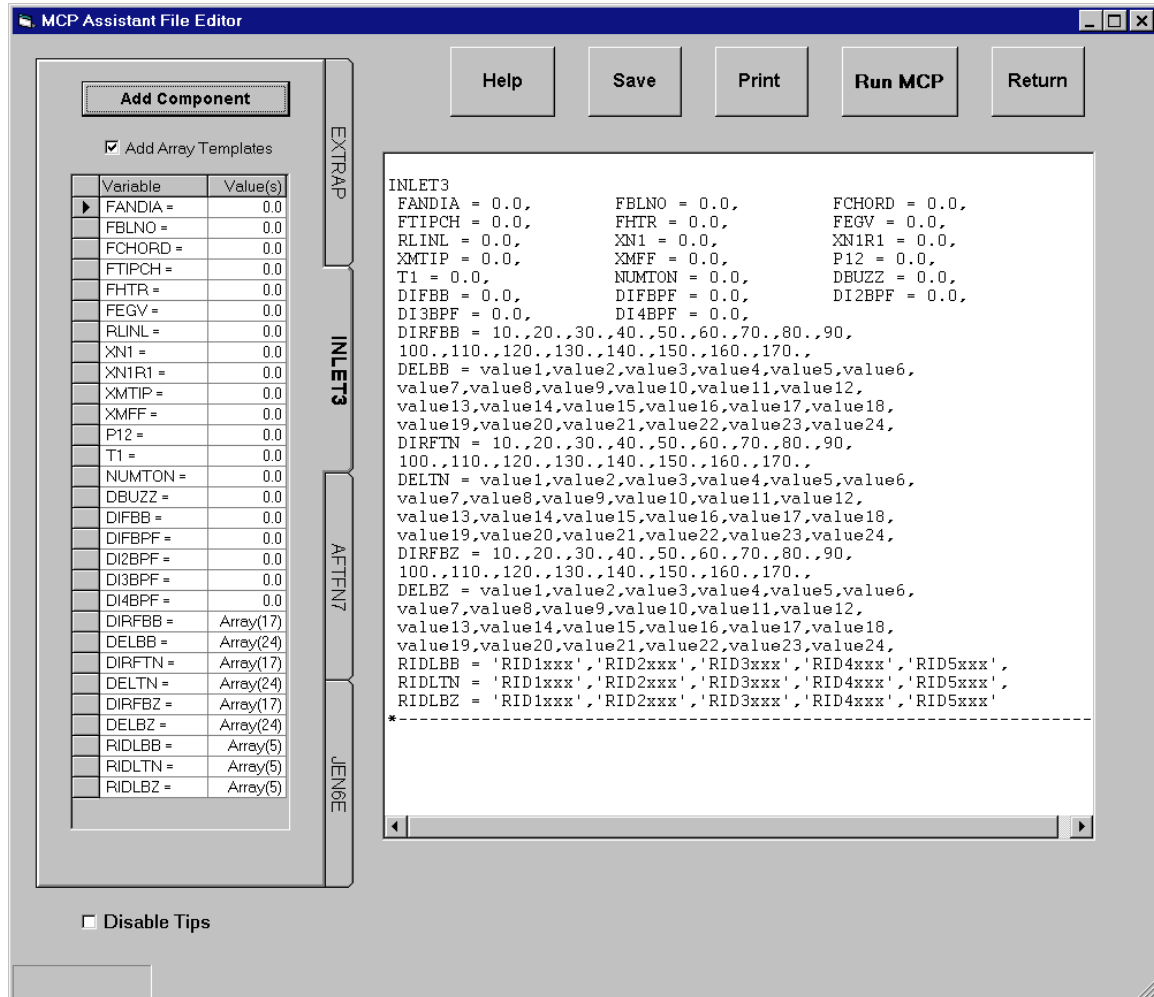


Figure 4 The MCP Assistant “File Editor” Screen with Spectral Delta Parameters Shown

The “File Editor” screen has buttons that allow the current input file to be saved to some specified name and location, and that allow the current input file to be printed out. From this screen one can return to the “MCP Assistant Main” screen (Figure 1), but the information on the File Editor screen will not be saved on that screen.

An input file can be created without the use of the MCP Assistant, but special care must then be taken to assure that correct formatting is followed (Section 6.1).

3.2 Opening and Editing an Existing Input File

Clicking the “Open Existing Input File” button from the MCP Assistant Main screen displays “Select The File” screen shown in Figure 5. Selecting a file and clicking on the “Use This File” button displays the “File Editor” screen, with the selected file shown in the main viewing area (Figure 3). The file can be edited using the full-screen editing feature of the main viewing area.

Select The File

Select An Existing MCP Input File

Drive: c:

File Type: RDS File(*.rds, *.txt)

Directories: c:\, Task10

example_input.txt
MCPCommand.txt
MCPU6.TXT
TestRun.rep.txt
TestRun.rst.txt
TestRun.sum.txt
TestRun.txt

File Name = example_input.txt Date 9/20/00 8:57:38 AM

TITLE 1 Modular Engine Noise Component Prediction System
TITLE 2 Example Run
TITLE 3 First Condition
TITLE 4 (up to four lines of title information allowed)
EXTRAP
*----- FLTPTH -----
ALTEVO= 18.0, SL = -150, VTAS = 0.0, FPA= 0.0,
PAE = 0.0, HMIC= 0.00, RNENG= 1,
*----- EXTRAP OPTIONS -----
RUNID = 1950, EGA = 0, ATMABS= 1, SHLD = 0,
GRDREF= 0, TCFLR= 30, TCBMIN= 17, PRCOMP= 1,
*----- WEATHER -----
TFSRC= 77.0, RHSRC= 70.0, PSISRC=14.7, WKTSRC= 0.0, WDGSRC= 0.0,
TFMIC= 77.0, RHMIC= 70.0, PSIMIC=14.7, WKTMIC= 0.0, WDMIC= 0.0

Cancel/Return Use This File

Figure 5 The MCP Assistant “Select The File” Screen

3.3 Executing the Program

Once an input file has been created and saved (by clicking the “Save” button on the “File Editor” screen (Figure 3)), the user can execute the program by clicking the “Run MCP” button on the “File Editor” screen. This displays the “Run MCP” screen shown in Figure 6.

MCP Assistant - Run MCP

Open Existing Save Current

View Execution Log Print Window View A File Run MCP Return

Input File View c:\Task10\program_checkout\example_input.txt

RST Output File View c:\Task10\program_checkout\example_output.rst.txt

Report File View c:\Task10\program_checkout\example_output.rep.txt

Summary File View c:\Task10\program_checkout\example_output.sum.txt

Noise Deltas File Select

TITLE 1 Modular Engine Noise Component Prediction System
TITLE 2 Example Run with No Deltas
TITLE 3 First Condition
TITLE 4 (up to four lines of title information allowed)
EXTRAP
*----- FLTPTH -----
ALTEVO= 18.0, SL = -150, VTAS = 0.0, FPA= 0.0,
PAE = 0.0, HMIC= 0.00, RNENG= 1,
*----- EXTRAP OPTIONS -----
RUNID = 1950, EGA = 0, ATMABS= 1, SHLD = 0,
GRDREF= 0, TCFLR= 30, TCBMIN= 17, PRCOMP= 1,
*----- WEATHER -----
TFSRC = 77.0, RHSRC= 70.0, PSISRC=14.7,
TFMIC = 77.0, RHMIC= 70.0, PSIMIC=14.7
=====

COMPONENTS
*-----
INLETS
XN1 = 2000., XN1R1 = 1950., XMTIP = 0.750,
FCHORD= 10.000, YMFY = 0.250, DI.TML = 5.00

Figure 6 The MCP Assistant “Run MCP” Screen

In the “Run MCP” screen the user specifies the input and output file locations and names. Note that once the input file is entered, certain default names are given to the output files; these can be edited as desired. For the optional report and summary files the user can enter an “s” (as in scratch, without the quotes) in order to not create that particular file. The “Noise Deltas File” is only required when applying deltas by the method described in Section 5.3. The MCP command file, which is a text file consisting of the five file names, can be saved by clicking on the “Save Current” button. Previously saved command files can be opened (in order to edit or to run) by clicking on the “Open Existing” button. Creating a command file allows the user to later run MCP without the use of the MCP Assistant program, as described in Section 4.

Once the output locations and names are specified, the user clicks on the “Run MCP” button to run the program. When the program is complete an Execution Log, named “mcpu6.txt,” appears in the main viewing area. The user can also view any of the other input/output files from this screen, by clicking on the appropriate “View” button.

4 Running MCP from an MS-DOS Command Line

MCP can be run from an MS-DOS command line by using the following calling sequence:

```
mcp.exe -i command_file
```

where *command_file* refers to a five-line text file that contains the locations and names of the input and output files shown on the “Run MCP” screen (Figure 6), one per line in the order shown. A command file

can be created using a text editor or by using the “Save Current MCP Command File” feature, as described in Section 3.3.

5 Applying Deltas

The user is able to alter the predicted noise levels (“apply deltas”) to account for such things as lining attenuation or installation effects. There are three different ways to do this, as described in the following sections.

5.1 Single Value for All Frequencies and Angles

The user can arithmetically add a single-valued delta to all sound pressure levels of a selected subcomponent of a particular component. For the INLET3 module these deltas are specified by the parameters DBUZZ (for the buzzsaw subcomponent), DIFBB (for the broadband subcomponent), and DIFBPF, DI2BPF, DI3BPF, and DI4BPF (for the tone levels at the blade passage frequency and its 2nd, 3rd, and 4th harmonics, respectively).

For the AFTFN7 module these deltas are specified by the parameters DABB (for the broadband subcomponent), and DABPF, DA2BPF, DA3BPF, and DA4BPF (for the tone levels at the blade passage frequency and its 2nd, 3rd, and 4th harmonics, respectively).

For the JEN6E module this delta is specified by the parameter DELJET. In this case, the delta is added to the final summation of the various jet subcomponents.

These delta parameters are shown in the example input file in Section 8.1 (for which they are all set to zero), and the parameters are defined in Sections 7.2, 7.3, and 7.4.

5.2 Spectral Deltas and Directivity Factors

A second way to apply subcomponent deltas is by specifying an array of spectral deltas and an array of directivity factors. The spectral deltas consist of 24 one-third octave band levels (corresponding to the frequency bands from 50 Hertz through 10,000 Hertz), and the directivity factors consist of 17 numbers corresponding to the angles from 10 through 170 degrees. The delta applied is the product of the appropriate spectral delta and directivity factor.

For the INLET3 module these spectral delta arrays are specified by the parameters DELBB, DELTN, and DELBZ (for the broadband, tone, and buzzsaw subcomponents, respectively), and the directivity factor arrays are specified by the parameters DIRFBB, DIRFTN, and DIRFBZ (for the broadband, tone, and buzzsaw subcomponents, respectively). For the AFTFN7 module these spectral delta arrays are specified by the parameters DELBB and DELTN (for the broadband and tone subcomponents, respectively), and the directivity factor arrays are specified by the parameters DIRFBB and DIRFTN (for the broadband and tone subcomponents, respectively). For the JEN6E module the spectral delta array is specified by the parameter DELBB and the directivity factor array is specified by the parameter DIRFBB.

The MCP Assistant “File Editor” screen used to create the input file is shown Figure 4, and discussed in Section 3.1; the delta parameters are shown in the example input file in Section 8.2; and the parameters are defined in Sections 7.2, 7.3, and 7.4.

5.3 Delta Values from a Separate File

A third way to apply subcomponent deltas is by specifying those deltas in a separate input file. This involves the three steps described in the following sections.

5.3.1 *Creating a Delta File*

An example of a delta file is shown in Section 8.4. The delta file follows the RDS formatting standards described in Section 6.3.1. It must contain the \$BEGIN, \$SCALARS, \$TABLE, \$VALUES, and \$END sections shown, and the delta array must have 24 frequency by 17 angle values per partition.

5.3.2 *Specifying Partition ID*

The input file must specify the appropriate partition ID from the delta file to be used for the particular subcomponent. For the INLET3 module the partition IDs are specified by the parameters RIDLBB, RIDLTN, and RIDLBZ (for the broadband, tone, and buzzsaw subcomponents, respectively). For the AFTFN7 module the partition IDs are specified by the parameters RIDLBB and RIDLTN (for the broadband and tone subcomponents, respectively). For the JEN6E module the partition ID is specified by the parameter RIDLBB. Note that the partition ID must appear in single quotes in the input file.

The MCP Assistant “File Editor” screen used to create the input file is shown Figure 4, and discussed in Section 3.1; the delta parameters are shown in the example input file in Section 8.3, and the parameters are defined in Sections 7.2, 7.3, and 7.4.

5.3.3 *Specifying Delta File*

The delta file location and name is specified when executing the program, as shown in Figure 6 and described in Section 3.3.

6 **File Formats**

This section describes the formatting of the various files associated with MCP.

6.1 Input Files

The MCP Assistant program generates appropriately formatted input files. However if the user generates the input file without using the Assistant program, the following formatting requirements must be followed. Examples of input files are shown in Section 8, and parameter definitions are given in Section 7.

Information can be read from columns 1 through 80 of the input file. Blank lines, or lines beginning with an asterisk in column one, can be inserted anywhere in the input file for purposes of documentation, organization, or appearance.

6.1.1 *TITLE Section*

The title Section consists of up to four lines of title information. The space between word “TITLE” and the line number is required, but text may immediately follow the line number. Only the first 73 characters of each line of text are stored in the title array. Titles are output at the beginning of each component partition of the RST-formatted output file (Section 9.1).

6.1.2 *EXTRAP Module*

The first module that is required to run MCP is EXTRAP. This module contains parameters describing the flight path, the atmospheric conditions, and specific extrapolation and propagation options. These parameters are defined in Section 7.1.

The module begins with the term “EXTRAP” starting in the first column. Subsequent lines follow the format of “PARAMETER = VALUE” (with any spaces immediately before and after the equal sign ignored). MCP continues to read parameter pairs as inputs to the module as long as a comma follows the pair. The last pair is not followed by a comma, and this indicates the end of inputs to that particular module.

6.1.3 *COMPONENT Modules*

Following the EXTRAP module inputs are one or more component module input blocks. These input blocks contain the engine geometry and performance parameters needed to predict particular component noise levels. These parameters are defined in Sections 7.2, 7.3, and 7.4, for the INLET3, AFTFN7, and JEN6E modules, respectively.

The component modules section begins with the word “COMPONENTS” starting in the first column. This is followed by input blocks of data that have the component name alone on the first line. Lines following the component name provide the appropriate input parameter names and values, following the same formatting conventions described for the EXTRAP module inputs (6.1.2).

When the user is specifying spectral deltas and directivity factors (Section 5.2) for a particular component, those inputs take the form of an array of values assigned to a parameter name. In this case a comma is also required between the individual values in the array, as shown in Section 8.2.

6.1.4 *END Command*

Multiple cases may be specified in a single input file. A repeated occurrence of TITLE or EXTRAP sections in the file signals the start of another prediction sequence. The final line of the input file consists of the word “END” beginning in column one.

6.2 Delta File

An example of a delta file is shown in Section 8.4. The delta file follows the RDS formatting standards described in Section 6.3.1. It must contain the \$BEGIN, \$SCALARS, \$TABLE, \$VALUES, and \$END sections shown, and the delta array must have 24 frequency by 17 angle values per partition.

6.3 Output Files

The user can save three different output files generated by MCP. All of these files follow the Boeing-developed Readable Data Standard (RDS) formatting conventions. These three output files are described in the following sections. Examples are shown in Section 8.4 and parameter definitions in Section 7.

6.3.1 *RST-formatted Spectra Output (RST Output File)*

The RST-formatted spectra output file contains predicted spectra versus emission angle as shown in Section 9.1. The term RST refers to a particular type of the more general RDS format. The RDS format was developed by Boeing to create a standard for using data with various analysis and plotting programs. Boeing has made available detailed descriptions of this format, as well as read and write subroutines for working with it. Following is a brief description of certain key elements of the RDS format.

The various sections of the file begin with a “\$” in the first column, followed by a keyword. These keywords include BEGIN, TITLE, SCALARS, ARRAYS, TABLES, and VALUES.

The \$BEGIN is followed, on the same line, by a partition identification.

The \$TITLE is followed, on different lines, by information about the file.

The \$SCALARS section consists of pairs of lines, the first with a series of parameter names and the second with the corresponding series of parameter values.

The \$ARRAYS section contains one-dimensional array data that are common to the entire partition. The parameter name (with the dimension of the array in parentheses appended to the parameter name), is on one line and is followed by however many values of that parameter are indicated by that appended dimension.

The “\$TABLE” section lists the parameter names for one-dimensional and two-dimensional array data. Immediately following the \$TABLE section is the \$VALUES section which contains the parameter values corresponding to the parameter names listed in the \$TABLE section.

Finally, the \$END line indicates the end of a partition. Multiple partitions can be present in the same file.

6.3.2 *Tabular Spectra Output (Report File)*

The tabular spectra output (shown in Section 9.2) is optional, and contains essentially the same information as the RST-formatted spectra output file, but with the spectra data in a tabular format.

6.3.3 *Noise Metric Output (Summary File)*

The noise metric output (shown in Section 9.3) is optional, and contains overall sound pressure levels and certain subjective noise metrics (e.g., perceived noise levels).

7 Parameter Definitions

7.1 EXTRAP Module

Parameter	Units	Definition
RUNID	-	4-digit run identifier in output file (conventionally N1C value)
ALTEVO	feet	Engine altitude at visual overhead
VTAS	knots	Velocity True Airspeed: (i.e., <u>not</u> indicated airspeed); zero for static predictions
FPA	degrees	Flight Path Angle: angle between airplane instantaneous flight path and the horizontal direction; positive for climb
PAE	degrees	Pitch Angle of the Engine: angle between engine axis and horizontal direction; equals the sum of the airplane flight path angle (FPA), the airplane body angle of attack, and the angle between the airplane ref. axis and the engine axis (referred to as the engine deflection angle); positive for inlet up
RNENG	-	Number of engines
SL	feet	Microphone sideline distance; negative for (static) polar arc predictions
HMIC	feet	Microphone height (used for propagation distance only)
EGA	-	Switch for extra ground attenuation: = 0, no EGA = 1, apply EGA
ATMABS	-	Switch for atmospheric absorption method: =0, ARP866A using center frequency up through 4 kHz band, and lower band edge frequency for 5 kHz and higher = 1, ARP866A using band center frequency only = 2, ANSI 1986 atmospheric absorption based on center frequency
SHLD	-	Switch for engine noise sideline shielding method: = 0, no shielding = 1, alternate model = 2, recommended model = 3, alternate model
GRDREF	-	Switch for 4-foot microphone reflection calculation method: = 0, free field = 1, alternate model = 2, recommended model
TCFLR	db	Tone correction SPL floor (one value for all angles and frequencies)
TCBMIN	-	Minimum band for which to calculate a tone correction for the PNLT calculation (note: band number = $10 \log(\text{frequency})$); usually band 17 (50 Hz) for free field spectra and band 29 (800 Hz) for 4-foot microphone spectra
TFSRC	degrees Fahrenheit	Ambient temperature at source location
RHSRC	per cent	Relative humidity at source location
PSISRC	pounds / inch ² (absolute)	Ambient pressure at source location
TFMIC	degrees	Ambient temperature at microphone location

Parameter	Units	Definition
	Fahrenheit	
RHMIC	per cent	Relative humidity at microphone location
PSIMIC	pounds / inch ² (absolute)	Ambient pressure at microphone location
PRCOMP	-	Switch for printing subcomponent data to output files: =0, no =1, yes

7.2 INLET3 Module

Parameter	Units	Definition
FANDIA	inches	Fan tip diameter at leading edge
FBLNO	-	Number of fan blades
FCHORD	inches	Actual fan tip chord (along mid-chord line)
FTIPCH	inches	Length of the projection of the fan tip chord onto the engine axis
FHTR	-	Ratio of fan hub diameter to fan blade tip diameter
FEGV	-	Number of fan exit guide vanes
RLINL	feet	Inlet length, cowl hilit to fan face root
XN1	rpm	Mechanical fan rotor speed
XN1R1	rpm	Corrected fan rotor speed
XMTIP	-	Fan relative tip Mach number (vector sum of fan tangential tip Mach number and fan face axial Mach number (XMFF))
XMFF	-	Average axial Mach number at fan face
P12	pounds / inch ² (absolute)	Fan face total pressure
T1	degrees Rankine	Free stream total temperature
NUMTON	-	Maximum number of fan tone harmonics to calculate
DBUZZ	db	Delta value applied to buzzsaw noise (single value)
DIFBB	db	Delta value applied to fan broadband (single value)
DIFBPF	db	Delta value applied to 1 st tone harmonic (single value)
DI2BPF	db	Delta value applied to 2 nd tone harmonic (single value)
DI3BPF	db	Delta value applied to 3 rd tone harmonic (single value)
DI4BPF	db	Delta value applied to 4 th tone harmonic (single value)
DIRFBB	-	Directivity factor array for broadband deltas (one value for each of the 17 angles)
DELBB	db	Spectra shape array for broadband deltas (one value for each of the 24 frequencies)

Parameter	Units	Definition
DIRFTN	-	Directivity factor array for tone deltas (one value for each of the 17 angles)
DELTN	db	Spectra shape array for tone deltas (one value for each of the 24 frequencies)
DIRFBZ	-	Directivity factor array for buzzsaw deltas (one value for each of the 17 angles)
DELBZ	db	Spectra shape array for buzzsaw deltas (one value for each of the 24 frequencies)
RIDLBB	db	Partition ID for spectral broadband deltas (array of up to five values)
RIDLTN	db	Partition ID for spectral tone deltas (array of up to five values)
RIDLBZ	db	Partition ID for spectral buzzsaw deltas (array of up to five values)

7.3 AFTFN7 Module

Parameter	Units	Definition
FANDIA	inches	Fan tip diameter at leading edge
FBLNO	-	Number of fan blades
FCHORD	inches	Actual fan tip chord (along mid-chord line)
XN1	rpm	Mechanical fan rotor speed
XMTIP	-	Fan relative tip Mach number (vector sum of fan tangential tip Mach number and fan face axial Mach number)
FANPR	-	Fan pressure ratio
SHLOG	-	Coefficient used in static-to-flight shear layer effect approximation (-SHLOG $\log_{10} (1-M \cos q)$, where M is free-stream Mach number and q is the Doppler angle)
MTNAFT	-	Maximum number of fan tone harmonics to calculate (value must be greater than one)
DABB	db	Delta value applied to fan broadband (single value)
DABPF	db	Delta value applied to 1 st tone harmonic (single value)
DA2BPF	db	Delta value applied to 2 nd tone harmonic (single value)
DA3BPF	db	Delta value applied to 3 rd tone harmonic (single value)
DA4BPF	db	Delta value applied to 4 th tone harmonic (single value)
DIRFBB	-	Directivity factor array for broadband deltas (one value for each of the 17 angles)
DELB	db	Spectra shape array for broadband deltas (one value for each of the 24 frequencies)
DIRFTN	-	Directivity factor array for tone deltas (one value for each of the 17 angles)
DELTN	db	Spectra shape array for tone deltas (one value for each of the 24 frequencies)
RIDLBB	db	Partition ID for spectral broadband deltas (array of up to five values)
RIDLTN	db	Partition ID for spectral tone deltas (array of up to five values)

7.4 JEN6E Module

Parameter	Units	Definition
FANDIA	inches	Fan tip diameter at leading edge
SDIST	feet	Axial distance from the engine reference point to the extended primary or common nozzle exit in the downstream direction (i.e., positive for exit downstream of reference)
RLFANE	feet	Axial distance between the fan blade leading edge (at the fan hub) and the secondary nozzle exit
PLUGD	feet	Primary nozzle plug diameter at the extended or common nozzle exit station
CHORDE	feet	Wing chord at the engine spanwise location; this parameter is used for calculating the jet/flap interaction effect; setting to 0 indicates that no effect will be calculated (e.g., as in the case of an engine test stand prediction)
XFC	feet	Horizontal distance of the secondary (fan) nozzle exit downstream of the wing leading edge; this parameter is used only if a jet/flap interaction effect is being calculated (as indicated by a non-zero value for CHORDE)
YFC	feet	Vertical distance (separation) between the secondary (fan) nozzle exit outer wall and the bottom surface of the wing; this parameter is used only if a jet/flap interaction effect is being calculated (as indicated by a non-zero value for CHORDE)
XN1	rpm	Mechanical fan rotor speed
AE7	feet ²	Effective jet exit area of primary (core or inner) flow stream
T7	degrees Rankine	Total temperature of primary (core or inner) flow stream
VJ17	feet/second	Ideal jet velocity of primary (core or inner) flow stream
W7	lbm/second	Mass flow rate of primary (core or inner) flow stream
AE17	feet ²	Effective jet exit area of secondary (fan or outer) flow stream
T17	degrees Rankine	Total temperature of secondary (fan or outer) flow stream
VJ17	feet/second	Ideal jet velocity of secondary (fan or outer) flow stream
W17	lbm/second	Mass flow rate of secondary (fan or outer) flow stream
RMIXJ	-	Switch for jet mixer prediction: = 0, no mixer = 1, mixer present (velocity, temperature, and mass flow values for primary and secondary streams set to fully mixed values)
DELJET	db	Delta value applied to jet noise (single value)
DIRFBB	-	Directivity factor array for broadband deltas (one value for each of the 17 angles)
DELBB	db	Spectra shape array for broadband deltas (one value for each of the 24 frequencies)
RIDLBB	db	Partition ID for spectral broadband deltas (array of up to five values)

7.5 Output Files

Following are the parameters (that have not been previously defined) appearing in the output files.

Parameter	Units	Definition
OASPL	db	Overall sound pressure level
DBA	db	A-weighted sound pressure level
DBD	db	D-weighted sound pressure level
PNL	db	Perceived noise level
PNLT	db	Tone-corrected perceived noise level
EPNL	db	Effective perceived noise level
SEL	db	Sound exposure level
FNR	pounds force	Thrust
RMXNYB	-	Maximum noy-weighted band
TCB	-	Tone correction band
EMANG	degrees	Noise emission angle (noise propagation re: inlet axis, 0 degrees forward)
TIMRVO	seconds	Time relative to visual overhead
DOPANG	degrees	Doppler angle (noise propagation re: flight path, 0 degrees forward)
SPDIST	feet	Sound propagation distance

8 Example Input Files

8.1 Input File for No Deltas

```

TITLE 1 Modular Engine Noise Component Prediction System
TITLE 2 Example Run with No Deltas
TITLE 3 First Condition
TITLE 4 (up to four lines of title information allowed)
EXTRAP
*----- FLTPTH -----
ALTEVO= 18.0, SL = -150, VTAS = 0.0, FPA= 0.0,
PAE = 0.0, HMIC= 0.00, RNENG= 1,
*----- EXTRAP OPTIONS -----
RUNID = 1950, EGA = 0, ATMABS= 1, SHLD = 0,
GRDREF= 0, TCFLR= 30, TCBMIN= 17, PRCOMP= 1,
*----- WEATHER -----
TFSRC = 77.0, RHSRC= 70.0, PSISRC=14.7,
TFMIC = 77.0, RHMIC= 70.0, PSIMIC=14.7
*=====
COMPONENTS
*-----
INLET3
XN1 = 2000., XN1R1 = 1950., XMTIP = 0.750,
FCHORD= 10.000, XMFF = 0.250, RLINL = 5.00,
FHTR = 0.375, FBLNO = 36, FANDIA= 90.0,
FTIPCH= 4.000, FEGV = 78, P12 = 14.675,
T1 =536.500, DBUZZ = 0.0, DIFBB = 0.0,
DIFBPF= 0.0, DI2BPF= 0.0, DI3BPF= 0.0,
DI4BPF= 0.0, NUMTON= 4
*-----
AFTFN7
XN1 = 2000., XMTIP = 0.750, FANPR = 1.200,
FBLNO = 36, FANDIA= 90.0, FCHORD= 10.000,
SHLOG = 40.0, DABB = 0.0, DABPF = 0.0,
DA2BPF= 0.0, DA3BPF= 0.0, DA4BPF= 0.0,
MTNAFT= 5
*-----
JEN6E
XN1 = 2000., FANDIA= 90.0, SDIST = 12.00,

```

```

AE7   = 6.50,      T7    = 1125.0,    VJI7  = 535.0,
AE17  = 19.00,     T17   = 570.0,    VJI17 = 530.0,
W7    = 115.0,     RLFANE= 7.50,    PLUGD = 0.0,
W17   = 725.0,     XFC    = -1.5,    YFC    = 2.5,
CHORDE= 25.0,     RMIXJ = 0.0,    DELJET= 0.0

```

```

*-----
TITLE 1 Modular Engine Noise Component Prediction System
TITLE 2 Example Run with No Deltas
TITLE 3 Second Condition
TITLE 4 (up to four lines of title information allowed)
EXTRAP

```

```

*----- FLTPTH -----
ALTEVO= 18.0, SL = -150, VTAS = 0.0, FPA= 0.0,
PAE = 0.0, HMIC= 0.00, RNENG= 1,

```

```

*----- EXTRAP OPTIONS -----
RUNID = 2450, EGA = 0, ATMABS= 1, SHLD = 0,
GRDREF= 0, TCFLR= 30, TCBMIN= 17, PRCOMP= 1,

```

```

*----- WEATHER -----
TFSRC = 77.0, RHSRC= 70.0, PSISRC=14.7,
TFMIC = 77.0, RHMIC= 70.0, PSIMIC=14.7

```

```

*=====
COMPONENTS

```

```

*-----
INLET3
XN1   = 2500.,    XN1R1 = 2450.,    XMTIP = 0.950,
FCHORD= 10.000,   XMFF  = 0.350,    RLINL = 5.00,
FHTR  = 0.375,    FBLNO = 36,      FANDIA= 90.0,
FTIPCH= 4.000,    FEGV  = 78,      P12   = 14.675,
T1     =536.500,   DBUZZ = 0.0,    DIFBB = 0.0,
DIFBPF= 0.0,      DI2BPF= 0.0,    DI3BPF= 0.0,
DI4BPF= 0.0,      NUMTON= 4

```

```

*-----
AFTFN7
XN1   = 2500.,    XMTIP = 0.950,    FANPR = 1.350,
FBLNO = 36,       FANDIA= 90.0,    FCHORD= 10.000,
SHLOG = 40.0,     DABB  = 0.0,    DABPF = 0.0,
DA2BPF= 0.0,      DA3BPF= 0.0,    DA4BPF= 0.0,
MTNAFT= 5

```

```

*-----
JEN6E
XN1   = 2500.,    FANDIA= 90.0,    SDIST = 12.00,
AE7   = 6.45,     T7    = 1200.0,   VJI7  = 800.0,
AE17  = 18.95,    T17   = 585.0,   VJI17 = 600.0,
W7    = 165.0,    RLFANE= 7.50,    PLUGD = 0.0,
W17   = 1000.0,   XFC    = -1.5,    YFC    = 2.5,
CHORDE= 25.0,     RMIXJ = 0.0,    DELJET= 0.0

```

```

*-----
TITLE 1 Modular Engine Noise Component Prediction System
TITLE 2 Example Run with No Deltas
TITLE 3 Third Condition
TITLE 4 (up to four lines of title information allowed)
EXTRAP

```

```

*----- FLTPTH -----
ALTEVO= 18.0, SL = -150, VTAS = 0.0, FPA= 0.0,
PAE = 0.0, HMIC= 0.00, RNENG= 1,

```

```

*----- EXTRAP OPTIONS -----
RUNID = 2950, EGA = 0, ATMABS= 1, SHLD = 0,
GRDREF= 0, TCFLR= 30, TCBMIN= 17, PRCOMP= 1,

```

```

*----- WEATHER -----
TFSRC = 77.0, RHSRC= 70.0, PSISRC=14.7,
TFMIC = 77.0, RHMIC= 70.0, PSIMIC=14.7

```

```

*=====
COMPONENTS

```

```

*-----
INLET3
XN1   = 3000.,    XN1R1 = 2950.,    XMTIP = 1.175,
FCHORD= 10.000,   XMFF  = 0.450,    RLINL = 5.00,
FHTR  = 0.375,    FBLNO = 36,      FANDIA= 90.0,
FTIPCH= 4.000,    FEGV  = 78,      P12   = 14.675,
T1     =536.500,   DBUZZ = 0.0,    DIFBB = 0.0,
DIFBPF= 0.0,      DI2BPF= 0.0,    DI3BPF= 0.0,
DI4BPF= 0.0,      NUMTON= 4

```

```

*-----

```

```

AFTFN7
  XN1   = 3000.,      XMTIP = 1.175,      FANPR = 1.500,
  FBLNO = 36,         FANDIA= 90.0,       FCHORD= 10.000,
  SHLOG = 40.0,       DABB  = 0.0,        DABPF = 0.0,
  DA2BPF= 0.0,       DA3BPF= 0.0,        DA4BPF= 0.0,
  MTNAFT= 5
*-----
JEN6E
  XN1   = 3000.,      FANDIA= 90.0,       SDIST = 12.00,
  AE7   = 6.40,       T7    = 1300.0,     VJI7  = 1050.0,
  AE17  = 18.90,      T17   = 600.0,     VJI17 = 700.0,
  W7    = 210.0,      RLFANE= 7.50,      PLUGD = 0.0,
  W17   = 1275.0,     XFC   = -1.5,      YFC   = 2.5,
  CHORDE= 25.0,      RMIXJ = 0.0,      DELJET= 0.0
*-----
END

```

8.2 Input File for Spectral Deltas and Directivity Factors

```

TITLE 1 Modular Engine Noise Component Prediction System
TITLE 2 Example Run - Deltas in Input File
TITLE 3 First Condition
TITLE 4 (up to four lines of title information allowed)
EXTRAP
*----- FLTPTH -----
  ALTEVO= 18.0,  SL  = -150,  VTAS = 0.0,  FPA= 0.0,
  PAE   = 0.0,  HMIC= 0.00,  RNENG= 1,
*----- EXTRAP OPTIONS -----
  RUNID = 1950,  EGA  = 0,  ATMABS= 1,  SHLD = 0,
  GRDREF= 0,  TCFLR= 30,  TCBMIN= 17,  PRCOMP= 1,
*----- WEATHER -----
  TFSRC = 77.0,  RHSRC= 70.0,  PSISRC=14.7,
  TFMIC = 77.0,  RHMIC= 70.0,  PSIMIC=14.7
*=====
COMPONENTS
*-----
INLET3
  XN1   = 2000.,      XN1R1 = 1950.,      XMTIP = 0.750,
  FCHORD= 10.000,     XMFF  = 0.250,      RLINL = 5.00,
  FHTR  = 0.375,     FBLNO = 36,         FANDIA= 90.0,
  FTIPCH= 4.000,     FEGV  = 78,        P12   = 14.675,
  T1    =536.500,    DBUZZ = 0.0,        DIFBB  = 0.0,
  DIFBPF= 0.0,      DI2BPF= 0.0,        DI3BPF= 0.0,
  DI4BPF= 0.0,      NUMTON= 4,
  DIRFBB= 0.4, 0.4, 0.5, 0.7, 1.0, 1.4, 1.6, 1.6,
           1.5, 1.3, 1.1, 0.9, 0.7, 0.5, 0.3, 0.1, 0.1,
  DELBB= -0.0, -0.0, -0.0, -0.0, -0.1, -0.3, -0.6, -1.1,
           -1.8, -2.7, -3.9, -5.0, -5.6, -5.7, -5.6, -5.4,
           -5.2, -4.9, -4.5, -3.7, -2.1, -0.7, -0.4, -0.1,
  DIRFTN= 0.4, 0.4, 0.5, 0.7, 1.0, 1.4, 1.6, 1.6,
           1.5, 1.3, 1.1, 0.9, 0.7, 0.5, 0.3, 0.1, 0.1,
  DELTN= -0.0, -0.0, -0.0, -0.0, -0.1, -0.3, -0.6, -1.1,
           -1.8, -2.7, -3.9, -5.0, -5.6, -5.7, -5.6, -5.4,
           -5.2, -4.9, -4.5, -3.7, -2.1, -0.7, -0.4, -0.1
*-----
AFTFN7
  XN1   = 2000.,      XMTIP = 0.750,      FANPR = 1.200,
  FBLNO = 36,         FANDIA= 90.0,       FCHORD= 10.000,
  SHLOG = 40.0,       DABB  = 0.0,        DABPF = 0.0,
  DA2BPF= 0.0,       DA3BPF= 0.0,        DA4BPF= 0.0,
  MTNAFT= 5,
  DIRFBB= 0.1, 0.1, 0.1, 0.1, 0.4, 0.7, 1.0, 1.1,
           1.1, 1.1, 1.1, 1.0, 0.9, 0.8, 0.6, 0.4, 0.3,
  DELBB= -0.0, -0.0, 0.0, 0.0, 0.0, 0.0, 0.0, -0.1,
           -0.2, -0.3, -0.6, -1.2, -1.9, -3.0, -4.9, -7.9,
           -11.6, -13.1, -10.9, -9.5, -8.6, -6.9, -4.9, -2.9,
  DIRFTN= 0.1, 0.1, 0.1, 0.1, 0.4, 0.7, 1.0, 1.1,
           1.1, 1.1, 1.1, 1.0, 0.9, 0.8, 0.6, 0.4, 0.3,
  DELTN= -0.0, -0.0, 0.0, 0.0, 0.0, 0.0, 0.0, -0.1,
           -0.2, -0.3, -0.6, -1.2, -1.9, -3.0, -4.9, -7.9,
           -11.6, -13.1, -10.9, -9.5, -8.6, -6.9, -4.9, -2.9
*-----
JEN6E

```



```

XN1  = 2000.,    FANDIA= 90.0,    SDIST = 12.00,
AE7  = 6.50,    T7    = 1125.0,    VJI7  = 535.0,
AE17 = 19.00,    T17   = 570.0,    VJI17 = 530.0,
W7   = 115.0,    RLFANE= 7.50,    PLUGD = 0.0,
W17  = 725.0,    XFC   = -1.5,    YFC   = 2.5,
CHORDE= 25.0,    RMIXJ = 0.0,    DELJET= 0.0
*-----
TITLE 1 Modular Engine Noise Component Prediction System
TITLE 2 Example Run - Deltas in Input File
TITLE 3 Second Condition
TITLE 4 (up to four lines of title information allowed)
EXTRAP
*-----
ALTEVO= 18.0, SL = -150, VTAS = 0.0, FPA= 0.0,
PAE = 0.0, HMIC= 0.00, RNENG= 1,
*-----
EXTRAP OPTIONS -----
RUNID = 2450, EGA = 0, ATMABS= 1, SHLD = 0,
GRDREF= 0, TCFLR= 30, TCBMIN= 17, PRCOMP= 1,
*-----
WEATHER -----
TFSRC = 77.0,    RHSRC= 70.0,    PSISRC=14.7,
TFMIC = 77.0,    RHMIC= 70.0,    PSIMIC=14.7
*=====
COMPONENTS
*-----
INLET3
XN1  = 2500.,    XN1R1 = 2450.,    XMTIP = 0.950,
FCHORD= 10.000,    XMFF = 0.350,    RLINL = 5.00,
FHTR  = 0.375,    FBLNO = 36,    FANDIA= 90.0,
FTIPCH= 4.000,    FEGV = 78,    P12 = 14.675,
T1    =536.500,    DBUZZ = 0.0,    DIFBB = 0.0,
DIFBPF= 0.0,    DI2BPF= 0.0,    DI3BPF= 0.0,
DI4BPF= 0.0,    NUMTON= 4,
DIRFBB= 0.4, 0.4, 0.5, 0.7, 1.0, 1.4, 1.6, 1.6,
1.5, 1.3, 1.1, 0.9, 0.7, 0.5, 0.3, 0.1, 0.1,
DELBBS= -0.0, -0.0, -0.0, -0.0, -0.0, -0.1, -0.3, -0.6,
-1.0, -1.7, -2.6, -3.7, -4.8, -5.3, -5.4, -5.3,
-5.1, -4.9, -4.7, -4.2, -3.5, -2.0, -0.7, -0.4,
DIRFTN= 0.4, 0.4, 0.5, 0.7, 1.0, 1.4, 1.6, 1.6,
1.5, 1.3, 1.1, 0.9, 0.7, 0.5, 0.3, 0.1, 0.1,
DELTN= -0.0, -0.0, -0.0, -0.0, -0.0, -0.1, -0.3, -0.6,
-1.0, -1.7, -2.6, -3.7, -4.8, -5.3, -5.4, -5.3,
-5.1, -4.9, -4.7, -4.2, -3.5, -2.0, -0.7, -0.4
*-----
AFTFN7
XN1  = 2500.,    XMTIP = 0.950,    FANPR = 1.350,
FBLNO = 36,    FANDIA= 90.0,    FCHORD= 10.000,
SHLOG = 40.0,    DABB = 0.0,    DABPF = 0.0,
DA2BPF= 0.0,    DA3BPF= 0.0,    DA4BPF= 0.0,
MTNAFT= 5,
DIRFBB= 0.1, 0.1, 0.1, 0.1, 0.4, 0.7, 1.0, 1.1,
1.1, 1.1, 1.1, 1.0, 0.9, 0.8, 0.6, 0.4, 0.3,
DELBBS= -0.0, -0.0, -0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,
-0.1, -0.2, -0.3, -0.5, -1.0, -1.6, -2.6, -4.3,
-6.8, -9.8, -11.0, -9.3, -8.1, -7.4, -5.8, -4.1,
DIRFTN= 0.1, 0.1, 0.1, 0.1, 0.4, 0.7, 1.0, 1.1,
1.1, 1.1, 1.1, 1.0, 0.9, 0.8, 0.6, 0.4, 0.3,
DELTN= -0.0, -0.0, -0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0,
-0.1, -0.2, -0.3, -0.5, -1.0, -1.6, -2.6, -4.3,
-6.8, -9.8, -11.0, -9.3, -8.1, -7.4, -5.8, -4.1
*-----
JEN6E
XN1  = 2500.,    FANDIA= 90.0,    SDIST = 12.00,
AE7  = 6.45,    T7    = 1200.0,    VJI7  = 800.0,
AE17 = 18.95,    T17   = 585.0,    VJI17 = 600.0,
W7   = 165.0,    RLFANE= 7.50,    PLUGD = 0.0,
W17  = 1000.0,    XFC   = -1.5,    YFC   = 2.5,
CHORDE= 25.0,    RMIXJ = 0.0,    DELJET= 0.0
*-----
TITLE 1 Modular Engine Noise Component Prediction System
TITLE 2 Example Run - Deltas in Input File
TITLE 3 Third Condition
TITLE 4 (up to four lines of title information allowed)
EXTRAP

```

```

*----- FLTPTH -----
ALTEVO= 18.0, SL = -150, VTAS = 0.0, FPA= 0.0,
PAE = 0.0, HMIC= 0.00, RNENG= 1,
*----- EXTRAP OPTIONS -----
RUNID = 2950, EGA = 0, ATMABS= 1, SHLD = 0,
GRDREF= 0, TCFLR= 30, TCBMIN= 17, PRCOMP= 1,
*----- WEATHER -----
TFSRC = 77.0, RHSRC= 70.0, PSISRC=14.7,
TFMIC = 77.0, RHMIC= 70.0, PSIMIC=14.7
=====
COMPONENTS
*-----
INLET3
XN1 = 3000., XN1R1 = 2950., XMTIP = 1.175,
FCHORD= 10.000, XMFF = 0.450, RLINL = 5.00,
FHTR = 0.375, FBLNO = 36, FANDIA= 90.0,
FTIPCH= 4.000, FEGV = 78, P12 = 14.675,
T1 =536.500, DBUZZ = 0.0, DIFBB = 0.0,
DIFBPF= 0.0, DI2BPF= 0.0, DI3BPF= 0.0,
DI4BPF= 0.0, NUMTON= 4,
DIRFBB= 0.4, 0.4, 0.5, 0.7, 1.0, 1.4, 1.6, 1.6,
1.5, 1.3, 1.1, 0.9, 0.7, 0.5, 0.3, 0.1, 0.1,
DELBB= -0.0, -0.0, -0.0, -0.0, -0.0, -0.0, -0.1, -0.2,
-0.5, -0.9, -1.4, -2.1, -3.1, -3.9, -4.4, -4.5,
-4.4, -4.2, -4.0, -3.9, -3.5, -2.8, -1.6, -0.6,
DIRFTN= 0.4, 0.4, 0.5, 0.7, 1.0, 1.4, 1.6, 1.6,
1.5, 1.3, 1.1, 0.9, 0.7, 0.5, 0.3, 0.1, 0.1,
DELTN= -0.0, -0.0, -0.0, -0.0, -0.0, -0.0, -0.1, -0.2,
-0.5, -0.9, -1.4, -2.1, -3.1, -3.9, -4.4, -4.5,
-4.4, -4.2, -4.0, -3.9, -3.5, -2.8, -1.6, -0.6,
DIRFBZ= 0.4, 0.5, 0.7, 0.9, 1.0, 1.0, 1.0, 1.0,
1.0, 1.0, 1.0, 0.9, 0.9, 0.9, 0.9, 0.8, 0.8,
DELBZ= -0.0, -0.0, -0.0, -0.0, -0.0, -0.0, -0.0, -0.0,
-0.0, -0.7, -4.2, -8.5, -12.7, -15.6, -17.0, -14.7,
-10.4, -6.3, -3.2, -0.4, -0.0, -0.0, -0.0, -0.0
*-----
AFTFN7
XN1 = 3000., XMTIP = 1.175, FANPR = 1.500,
FBLNO = 36, FANDIA= 90.0, FCHORD= 10.000,
SHLOG = 40.0, DABB = 0.0, DABPF = 0.0,
DA2BPF= 0.0, DA3BPF= 0.0, DA4BPF= 0.0,
MTNAFT= 5,
DIRFBB= 0.1, 0.1, 0.1, 0.1, 0.4, 0.7, 1.0, 1.1,
1.1, 1.1, 1.1, 1.0, 0.9, 0.8, 0.6, 0.4, 0.3,
DELBB= -0.0, -0.0, -0.0, -0.0, 0.0, 0.0, 0.0, 0.0,
0.0, -0.1, -0.2, -0.3, -0.4, -0.8, -1.3, -2.1,
-3.5, -5.4, -7.4, -7.9, -7.0, -6.4, -5.8, -4.7,
DIRFTN= 0.1, 0.1, 0.1, 0.1, 0.4, 0.7, 1.0, 1.1,
1.1, 1.1, 1.1, 1.0, 0.9, 0.8, 0.6, 0.4, 0.3,
DELTN= -0.0, -0.0, -0.0, -0.0, 0.0, 0.0, 0.0, 0.0,
0.0, -0.1, -0.2, -0.3, -0.4, -0.8, -1.3, -2.1,
-3.5, -5.4, -7.4, -7.9, -7.0, -6.4, -5.8, -4.7
*-----
JEN6E
XN1 = 3000., FANDIA= 90.0, SDIST = 12.00,
AE7 = 6.40, T7 = 1300.0, VJI7 = 1050.0,
AE17 = 18.90, T17 = 600.0, VJI17 = 700.0,
W7 = 210.0, RLFANE= 7.50, PLUGD = 0.0,
W17 = 1275.0, XFC = -1.5, YFC = 2.5,
CHORDE= 25.0, RMIXJ = 0.0, DELJET= 0.0
*-----
END

```

8.3 Input File for Deltas from Separate File

```

TITLE 1 Modular Engine Noise Component Prediction System
TITLE 2 Example Run - Deltas from Separate File
TITLE 3 First Condition
TITLE 4 (up to four lines of title information allowed)
EXTRAP
*----- FLTPTH -----
ALTEVO= 18.0, SL = -150, VTAS = 0.0, FPA= 0.0,
PAE = 0.0, HMIC= 0.00, RNENG= 1,

```

```

*----- EXTRAP OPTIONS -----
RUNID = 1950, EGA = 0, ATMABS= 1, SHLD = 0,
GRDREF= 0, TCFLR= 30, TCBMIN= 17, PRCOMP= 1,
*----- WEATHER -----
TFSRC = 77.0, RHSRC= 70.0, PSISRC=14.7,
TFMIC = 77.0, RHMIC= 70.0, PSIMIC=14.7
*=====
COMPONENTS
*-----
INLET3
  XN1 = 2000., XN1R1 = 1950., XMTIP = 0.750,
  FCHORD= 10.000, XMFF = 0.250, RLINL = 5.00,
  FHTR = 0.375, FBLNO = 36, FANDIA= 90.0,
  FTIPCH= 4.000, FEGV = 78, P12 = 14.675,
  T1 =536.500, DBUZZ = 0.0, DIFBB = 0.0,
  DIFBPF= 0.0, DI2BPF= 0.0, DI3BPF= 0.0,
  DI4BPF= 0.0, NUMTON= 4, RIDLBB='DELINLO',
  RIDLTN='DELINLO'
*-----
AFTFN7
  XN1 = 2000., XMTIP = 0.750, FANPR = 1.200,
  FBLNO = 36, FANDIA= 90.0, FCHORD= 10.000,
  SHLOG = 40.0, DABB = 0.0, DABPF = 0.0,
  DA2BPF= 0.0, DA3BPF= 0.0, DA4BPF= 0.0,
  MTNAFT= 5, RIDLBB='DELAFL0', RIDLTN='DELAFL0'
*-----
JEN6E
  XN1 = 2000., FANDIA= 90.0, SDIST = 12.00,
  AE7 = 6.50, T7 = 1125.0, VJI7 = 535.0,
  AE17 = 19.00, T17 = 570.0, VJI17 = 530.0,
  W7 = 115.0, RLFANE= 7.50, PLUGD = 0.0,
  W17 = 725.0, XFC = -1.5, YFC = 2.5,
  CHORDE= 25.0, RMIXJ = 0.0, DELJET= 0.0
*-----
TITLE 1 Modular Engine Noise Component Prediction System
TITLE 2 Example Run - Deltas from Separate File
TITLE 3 Second Condition
TITLE 4 (up to four lines of title information allowed)
EXTRAP
*----- FLTPTH -----
ALTEVO= 18.0, SL = -150, VTAS = 0.0, FPA= 0.0,
PAE = 0.0, HMIC= 0.00, RNENG= 1,
*----- EXTRAP OPTIONS -----
RUNID = 2450, EGA = 0, ATMABS= 1, SHLD = 0,
GRDREF= 0, TCFLR= 30, TCBMIN= 17, PRCOMP= 1,
*----- WEATHER -----
TFSRC = 77.0, RHSRC= 70.0, PSISRC=14.7,
TFMIC = 77.0, RHMIC= 70.0, PSIMIC=14.7
*=====
COMPONENTS
*-----
INLET3
  XN1 = 2500., XN1R1 = 2450., XMTIP = 0.950,
  FCHORD= 10.000, XMFF = 0.350, RLINL = 5.00,
  FHTR = 0.375, FBLNO = 36, FANDIA= 90.0,
  FTIPCH= 4.000, FEGV = 78, P12 = 14.675,
  T1 =536.500, DBUZZ = 0.0, DIFBB = 0.0,
  DIFBPF= 0.0, DI2BPF= 0.0, DI3BPF= 0.0,
  DI4BPF= 0.0, NUMTON= 4, RIDLBB='DELINLO',
  RIDLTN='DELINLO'
*-----
AFTFN7
  XN1 = 2500., XMTIP = 0.950, FANPR = 1.350,
  FBLNO = 36, FANDIA= 90.0, FCHORD= 10.000,
  SHLOG = 40.0, DABB = 0.0, DABPF = 0.0,
  DA2BPF= 0.0, DA3BPF= 0.0, DA4BPF= 0.0,
  MTNAFT= 5, RIDLBB='DELAFL0', RIDLTN='DELAFL0'
*-----
JEN6E
  XN1 = 2500., FANDIA= 90.0, SDIST = 12.00,
  AE7 = 6.45, T7 = 1200.0, VJI7 = 800.0,
  AE17 = 18.95, T17 = 585.0, VJI17 = 600.0,
  W7 = 165.0, RLFANE= 7.50, PLUGD = 0.0,

```

```

W17 = 1000.0,   XFC = -1.5,   YFC = 2.5,
CHORDE= 25.0,   RMIXJ = 0.0,   DELJET= 0.0
*-----
TITLE 1 Modular Engine Noise Component Prediction System
TITLE 2 Example Run - Deltas from Separate File
TITLE 3 Third Condition
TITLE 4 (up to four lines of title information allowed)
EXTRAP
*----- FLTPTH -----
ALTEVO= 18.0, SL = -150, VTAS = 0.0, FPA= 0.0,
PAE = 0.0, HMIC= 0.00, RNENG= 1,
*----- EXTRAP OPTIONS -----
RUNID = 2950, EGA = 0, ATMABS= 1, SHLD = 0,
GRDREF= 0, TCFLR= 30, TCBMIN= 17, PRCOMP= 1,
*----- WEATHER -----
TFSRC = 77.0, RHSRC= 70.0, PSISRC=14.7,
TFMIC = 77.0, RHMIC= 70.0, PSIMIC=14.7
*=====
COMPONENTS
*-----
INLET3
XN1 = 3000., XN1R1 = 2950., XMTIP = 1.175,
FCHORD= 10.000, XMFF = 0.450, RLINL = 5.00,
FHTR = 0.375, FBLNO = 36, FANDIA= 90.0,
FTIPCH= 4.000, FEGV = 78, P12 = 14.675,
T1 =536.500, DBUZZ = 0.0, DIFBB = 0.0,
DIFBPF= 0.0, DI2BPF= 0.0, DI3BPF= 0.0,
DI4BPF= 0.0, NUMTON= 4, RIDLBB='DELINHI',
RIDLTN='DELINHI', RIDLBZ='DELINHI'
*-----
AFTFN7
XN1 = 3000., XMTIP = 1.175, FANPR = 1.500,
FBLNO = 36, FANDIA= 90.0, FCHORD= 10.000,
SHLOG = 40.0, DABB = 0.0, DABPF = 0.0,
DA2BPF= 0.0, DA3BPF= 0.0, DA4BPF= 0.0,
MTNAFT= 5, RIDLBB='DELAFHI', RIDLTN='DELAFHI'
*-----
JEN6E
XN1 = 3000., FANDIA= 90.0, SDIST = 12.00,
AE7 = 6.40, T7 = 1300.0, VJI7 = 1050.0,
AE17 = 18.90, T17 = 600.0, VJI17 = 700.0,
W7 = 210.0, RLFANE= 7.50, PLUGD = 0.0,
W17 = 1275.0, XFC = -1.5, YFC = 2.5,
CHORDE= 25.0, RMIXJ = 0.0, DELJET= 0.0
*-----
END

```

8.4 Delta File

```

$BEGIN DELINLO
$SCALARS
NBAND
24
$TABLE
EMANG
SPL(NBAND)
$VALUES
10.0 -0.1 -0.1 -0.2 -0.3 -0.5 -0.7 -1.0 -1.3 -1.6 -2.1 -2.4 -2.7
      -2.9 -3.0 -3.1 -3.1 -3.0 -2.4 -2.1 -2.5 -2.7 -2.5 -2.2 -1.7
20.0 -0.1 -0.1 -0.2 -0.3 -0.5 -0.7 -0.9 -1.1 -1.4 -1.8 -2.0 -2.3
      -2.4 -2.5 -2.5 -2.5 -2.3 -1.9 -1.8 -2.2 -2.2 -2.1 -1.8 -1.7
30.0 -0.1 -0.1 -0.2 -0.3 -0.4 -0.6 -0.9 -1.2 -1.6 -2.0 -2.3 -2.6
      -2.9 -3.0 -3.1 -3.1 -2.8 -2.3 -2.1 -2.6 -2.8 -2.6 -2.2 -1.8
40.0 -0.1 -0.2 -0.2 -0.3 -0.5 -0.8 -1.1 -1.5 -1.9 -2.4 -2.8 -3.1
      -3.4 -3.5 -3.7 -3.6 -3.1 -2.5 -2.6 -3.1 -3.3 -3.0 -2.5 -2.3
50.0 -0.2 -0.3 -0.4 -0.5 -0.8 -1.2 -1.7 -2.2 -2.9 -3.6 -4.2 -4.8
      -5.2 -5.5 -5.6 -5.5 -4.6 -3.6 -3.9 -4.7 -4.8 -4.3 -3.6 -3.4
60.0 -0.2 -0.3 -0.5 -0.7 -1.0 -1.4 -2.0 -2.7 -3.7 -4.8 -6.1 -7.4

```

	-8.8	-9.8	-10.3	-9.8	-7.3	-4.8	-6.2	-8.1	-7.9	-7.2	-5.3	-4.9
70.0	-0.4	-0.5	-0.7	-1.0	-1.4	-2.0	-2.8	-3.8	-5.1	-6.5	-8.0	-9.5
	-11.0	-12.3	-12.9	-12.5	-9.8	-6.9	-8.8	-11.2	-11.2	-10.3	-7.8	-7.4
80.0	-0.5	-0.6	-0.9	-1.2	-1.7	-2.3	-3.1	-4.0	-5.2	-6.4	-7.6	-8.5
	-8.9	-8.7	-8.6	-8.6	-7.3	-5.9	-7.0	-8.5	-8.7	-8.0	-6.7	-6.9
90.0	-0.5	-0.6	-0.9	-1.3	-1.9	-2.5	-3.3	-4.3	-5.5	-6.7	-7.8	-8.7
	-8.9	-8.7	-8.7	-8.7	-7.4	-5.8	-6.7	-8.2	-8.5	-7.8	-6.4	-6.3
100.0	-0.5	-0.7	-1.0	-1.4	-1.8	-2.5	-3.3	-4.3	-5.3	-6.5	-7.4	-8.1
	-8.4	-8.2	-8.2	-8.2	-6.9	-5.4	-6.4	-7.9	-8.0	-7.3	-6.0	-6.2
110.0	-0.5	-0.6	-0.9	-1.3	-1.7	-2.3	-3.1	-3.9	-4.9	-5.9	-6.8	-7.2
	-7.3	-7.2	-7.3	-7.3	-6.2	-4.8	-5.6	-6.9	-7.1	-6.5	-5.3	-5.4
120.0	-0.5	-0.6	-0.9	-1.2	-1.7	-2.2	-3.0	-3.8	-4.8	-5.9	-6.7	-7.0
	-7.1	-7.1	-7.3	-7.2	-6.1	-4.6	-5.5	-6.8	-7.0	-6.3	-5.0	-5.1
130.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
140.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
150.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
160.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
170.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
\$END												
\$BEGIN DELINHI												
\$SCALARS												
NBAND												
24												
\$TABLE												
EMANG												
SPL(NBAND)												
\$VALUES												
10.0	-0.1	-0.2	-0.3	-0.4	-0.5	-0.8	-1.1	-1.5	-1.9	-2.3	-2.6	-3.0
	-3.2	-3.3	-3.4	-3.4	-3.2	-2.6	-2.3	-2.7	-3.0	-2.8	-2.4	-1.9
20.0	-0.1	-0.1	-0.2	-0.3	-0.5	-0.7	-1.0	-1.3	-1.7	-2.0	-2.2	-2.4
	-2.6	-2.7	-2.7	-2.7	-2.5	-2.0	-2.0	-2.3	-2.5	-2.3	-2.0	-1.8
30.0	-0.1	-0.1	-0.2	-0.3	-0.5	-0.7	-1.0	-1.4	-1.8	-2.2	-2.5	-2.8
	-3.0	-3.2	-3.2	-3.3	-3.0	-2.5	-2.3	-2.7	-2.9	-2.7	-2.3	-2.0
40.0	-0.1	-0.2	-0.3	-0.4	-0.6	-0.8	-1.1	-1.5	-2.0	-2.5	-2.8	-3.1
	-3.4	-3.6	-3.7	-3.7	-3.2	-2.6	-2.6	-3.1	-3.3	-3.0	-2.5	-2.4
50.0	-0.1	-0.2	-0.4	-0.6	-0.9	-1.2	-1.7	-2.3	-2.9	-3.6	-4.2	-4.7
	-5.0	-5.3	-5.4	-5.3	-4.6	-3.6	-3.8	-4.6	-4.7	-4.3	-3.5	-3.3
60.0	-0.2	-0.3	-0.5	-0.7	-1.0	-1.5	-2.0	-2.8	-3.7	-4.7	-5.7	-6.8
	-7.7	-8.4	-8.7	-8.4	-6.5	-4.5	-5.5	-7.0	-6.9	-6.2	-4.8	-4.6
70.0	-0.4	-0.6	-0.8	-1.1	-1.5	-2.1	-3.0	-4.0	-5.2	-6.5	-7.7	-9.0
	-10.1	-11.1	-11.6	-11.4	-9.1	-6.8	-8.2	-10.2	-10.1	-9.2	-7.2	-7.1
80.0	-0.5	-0.7	-0.9	-1.3	-1.8	-2.5	-3.3	-4.3	-5.3	-6.5	-7.5	-8.2
	-8.4	-8.3	-8.3	-8.3	-7.2	-5.9	-6.8	-8.2	-8.4	-7.8	-6.5	-6.8
90.0	-0.5	-0.7	-1.0	-1.4	-1.9	-2.6	-3.5	-4.4	-5.5	-6.6	-7.5	-8.3
	-8.5	-8.3	-8.3	-8.3	-7.2	-5.8	-6.5	-7.9	-8.1	-7.4	-6.2	-6.2
100.0	-0.6	-0.7	-1.1	-1.5	-2.0	-2.6	-3.5	-4.4	-5.5	-6.5	-7.3	-7.9
	-8.1	-7.9	-7.9	-7.9	-6.7	-5.3	-6.3	-7.6	-7.7	-7.1	-5.8	-6.1

110.0	-0.5	-0.7	-1.0	-1.4	-1.9	-2.5	-3.2	-4.0	-5.0	-5.9	-6.6	-6.9
	-7.0	-6.9	-6.9	-6.9	-6.0	-4.8	-5.5	-6.6	-6.7	-6.1	-5.1	-5.2
120.0	-0.6	-0.7	-1.0	-1.3	-1.8	-2.4	-3.1	-3.9	-4.8	-5.8	-6.5	-6.9
	-7.0	-6.9	-7.0	-6.9	-5.9	-4.6	-5.3	-6.5	-6.6	-6.0	-4.9	-5.0
130.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
140.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
150.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
160.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
170.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
\$END												
\$BEGIN DELAFLO												
\$SCALARS												
NBAND												
24												
\$TABLE												
EMANG												
SPL(NBAND)												
\$VALUES												
10.0	-0.4	-0.5	-0.8	-1.2	-1.7	-2.5	-3.3	-4.3	-5.3	-6.3	-7.2	-7.8
	-8.2	-8.5	-8.6	-8.6	-8.4	-7.2	-6.0	-6.9	-7.6	-7.1	-6.3	-5.1
20.0	-0.4	-0.5	-0.8	-1.2	-1.8	-2.5	-3.3	-4.3	-5.4	-6.5	-7.3	-8.0
	-8.4	-8.7	-8.8	-8.8	-8.6	-7.4	-6.3	-7.3	-8.0	-7.5	-6.8	-5.4
30.0	-0.3	-0.5	-0.8	-1.2	-1.7	-2.5	-3.4	-4.5	-5.6	-6.7	-7.6	-8.3
	-8.8	-9.2	-9.3	-9.4	-9.2	-7.8	-6.5	-7.7	-8.6	-8.2	-7.4	-5.6
40.0	-0.3	-0.5	-0.7	-1.2	-1.7	-2.5	-3.3	-4.3	-5.4	-6.4	-7.3	-8.1
	-8.6	-8.9	-9.1	-9.1	-8.9	-7.5	-6.3	-7.4	-8.2	-7.8	-7.0	-5.3
50.0	-0.3	-0.5	-0.8	-1.1	-1.6	-2.3	-3.1	-4.1	-5.1	-6.1	-6.9	-7.5
	-8.0	-8.3	-8.5	-8.5	-8.3	-7.0	-5.7	-6.8	-7.5	-7.2	-6.4	-4.8
60.0	-0.3	-0.4	-0.7	-1.0	-1.5	-2.2	-3.0	-3.8	-4.8	-5.8	-6.5	-7.1
	-7.5	-7.8	-8.0	-8.0	-7.8	-6.6	-5.4	-6.4	-7.2	-6.8	-6.1	-4.5
70.0	-0.2	-0.4	-0.6	-0.9	-1.4	-2.0	-2.7	-3.5	-4.5	-5.3	-6.1	-6.7
	-7.1	-7.4	-7.6	-7.6	-7.4	-6.2	-5.1	-6.0	-6.8	-6.5	-5.7	-4.2
80.0	-0.2	-0.3	-0.6	-0.9	-1.4	-2.0	-2.7	-3.5	-4.5	-5.3	-6.1	-6.6
	-7.0	-7.3	-7.4	-7.4	-7.2	-6.1	-5.0	-5.9	-6.6	-6.3	-5.5	-4.0
90.0	-0.2	-0.3	-0.6	-0.9	-1.4	-2.0	-2.8	-3.7	-4.7	-5.6	-6.4	-6.9
	-7.3	-7.5	-7.6	-7.5	-7.3	-6.1	-5.0	-5.8	-6.5	-6.2	-5.4	-3.9
100.0	-0.2	-0.3	-0.5	-0.8	-1.3	-2.0	-2.8	-3.7	-4.6	-5.5	-6.3	-6.9
	-7.3	-7.5	-7.7	-7.7	-7.5	-6.3	-5.1	-6.1	-6.8	-6.4	-5.7	-4.1
110.0	-0.2	-0.3	-0.5	-0.9	-1.4	-2.0	-2.8	-3.8	-4.8	-5.9	-6.8	-7.6
	-8.2	-8.6	-8.9	-8.9	-8.8	-7.3	-5.9	-7.2	-8.0	-7.6	-6.8	-4.9
120.0	-0.2	-0.3	-0.5	-0.9	-1.3	-1.9	-2.6	-3.5	-4.6	-5.6	-6.5	-7.2
	-7.8	-8.1	-8.3	-8.4	-8.3	-6.9	-5.6	-6.7	-7.6	-7.2	-6.4	-4.6
130.0	-0.2	-0.3	-0.4	-0.6	-0.9	-1.4	-2.0	-2.7	-3.4	-4.2	-4.8	-5.3
	-5.6	-5.8	-5.9	-5.9	-5.8	-4.8	-4.0	-4.8	-5.4	-5.1	-4.5	-3.3
140.0	-0.4	-0.5	-0.6	-0.8	-1.1	-1.6	-2.2	-2.9	-3.7	-4.4	-5.1	-5.6
	-6.0	-6.2	-6.3	-6.3	-6.2	-5.1	-4.2	-5.0	-5.7	-5.4	-4.7	-3.4

150.0	3.7	3.6	3.6	3.4	3.0	2.6	2.1	1.4	0.6	-0.1	-0.7	-1.2
	-1.6	-1.8	-1.9	-1.8	-1.6	-0.6	0.4	-0.4	-1.0	-0.7	0.0	1.4
160.0	0.2	0.1	-0.1	-0.4	-0.8	-1.3	-2.0	-2.8	-3.7	-4.5	-5.2	-5.7
	-6.1	-6.4	-6.5	-6.5	-6.3	-5.3	-4.2	-5.1	-5.8	-5.5	-4.9	-3.4
170.0	0.3	0.2	0.0	-0.3	-0.6	-1.2	-1.9	-2.6	-3.5	-4.3	-5.0	-5.5
	-6.0	-6.3	-6.4	-6.4	-6.2	-5.2	-4.1	-5.0	-5.6	-5.3	-4.7	-3.2
\$END												
\$BEGIN DELAFHI												
\$SCALARS												
NBAND												
24												
\$TABLE												
EMANG												
SPL(NBAND)												
\$VALUES												
10.0	-0.5	-0.7	-1.1	-1.5	-2.2	-3.0	-4.0	-5.0	-6.1	-7.1	-7.8	-8.5
	-8.9	-9.2	-9.3	-9.3	-9.1	-7.9	-6.8	-7.7	-8.5	-8.2	-7.6	-6.1
20.0	-0.6	-0.8	-1.1	-1.5	-2.2	-3.0	-4.0	-5.1	-6.2	-7.2	-8.1	-8.7
	-9.1	-9.4	-9.6	-9.6	-9.5	-8.2	-7.0	-8.0	-8.8	-8.4	-7.5	-5.8
30.0	-0.5	-0.7	-1.1	-1.5	-2.1	-3.0	-4.0	-5.1	-6.2	-7.2	-8.1	-8.6
	-9.0	-9.3	-9.5	-9.6	-9.4	-8.1	-6.9	-7.9	-8.7	-8.3	-7.5	-5.8
40.0	-0.4	-0.6	-1.0	-1.4	-2.0	-2.8	-3.8	-4.8	-5.8	-6.8	-7.5	-8.1
	-8.5	-8.8	-8.9	-8.9	-8.7	-7.5	-6.3	-7.3	-8.0	-7.6	-6.8	-5.3
50.0	-0.5	-0.6	-1.0	-1.4	-2.0	-2.8	-3.7	-4.7	-5.7	-6.6	-7.3	-7.8
	-8.2	-8.4	-8.5	-8.5	-8.3	-7.1	-6.0	-6.9	-7.6	-7.2	-6.5	-5.0
60.0	-0.4	-0.6	-0.9	-1.3	-1.9	-2.6	-3.5	-4.4	-5.3	-6.2	-6.9	-7.5
	-7.8	-8.0	-8.1	-8.2	-8.0	-6.9	-5.8	-6.8	-7.4	-7.1	-6.4	-4.9
70.0	-0.4	-0.6	-0.9	-1.3	-1.9	-2.7	-3.6	-4.5	-5.4	-6.3	-7.0	-7.5
	-7.8	-8.0	-8.1	-8.2	-8.0	-6.8	-5.8	-6.7	-7.3	-7.0	-6.3	-4.8
80.0	-0.4	-0.6	-0.9	-1.3	-1.8	-2.5	-3.4	-4.3	-5.3	-6.2	-6.9	-7.4
	-7.7	-7.9	-8.1	-8.1	-7.9	-6.8	-5.8	-6.6	-7.2	-7.0	-6.2	-4.7
90.0	-0.4	-0.5	-0.8	-1.2	-1.8	-2.5	-3.4	-4.3	-5.3	-6.1	-6.8	-7.3
	-7.7	-7.8	-7.9	-7.9	-7.8	-6.7	-5.7	-6.6	-7.2	-6.9	-6.2	-4.7
100.0	-0.4	-0.6	-0.9	-1.3	-1.9	-2.6	-3.6	-4.5	-5.6	-6.5	-7.3	-7.9
	-8.3	-8.5	-8.6	-8.6	-8.4	-7.3	-6.1	-7.1	-7.7	-7.3	-6.5	-4.9
110.0	-0.5	-0.6	-0.9	-1.3	-1.9	-2.7	-3.5	-4.5	-5.5	-6.5	-7.2	-7.8
	-8.2	-8.5	-8.6	-8.7	-8.5	-7.4	-6.3	-7.3	-8.0	-7.7	-7.0	-5.4
120.0	-0.3	-0.5	-0.7	-1.1	-1.5	-2.2	-2.9	-3.8	-4.7	-5.6	-6.4	-6.9
	-7.3	-7.6	-7.8	-7.8	-7.6	-6.5	-5.4	-6.4	-7.1	-6.8	-6.2	-4.6
130.0	-0.7	-0.8	-1.0	-1.4	-1.9	-2.5	-3.2	-3.9	-4.7	-5.5	-6.1	-6.5
	-6.8	-7.1	-7.2	-7.2	-7.0	-6.1	-5.3	-6.1	-6.7	-6.5	-5.9	-4.6
140.0	-0.3	-0.4	-0.7	-1.1	-1.6	-2.3	-3.0	-3.9	-4.8	-5.7	-6.4	-6.9
	-7.3	-7.5	-7.6	-7.6	-7.5	-6.5	-5.5	-6.3	-7.0	-6.7	-6.0	-4.6
150.0	-0.2	-0.4	-0.7	-1.0	-1.6	-2.2	-3.0	-3.9	-4.9	-5.7	-6.3	-6.9
	-7.3	-7.5	-7.6	-7.6	-7.5	-6.4	-5.5	-6.3	-7.0	-6.6	-5.9	-4.5
160.0	-0.3	-0.4	-0.7	-1.0	-1.5	-2.2	-3.0	-3.8	-4.8	-5.6	-6.3	-6.8
	-7.2	-7.4	-7.5	-7.5	-7.4	-6.4	-5.4	-6.3	-6.9	-6.7	-6.0	-4.6
170.0	-0.2	-0.4	-0.7	-1.0	-1.6	-2.2	-3.0	-3.8	-4.7	-5.5	-6.2	-6.7
	-7.1	-7.3	-7.5	-7.5	-7.3	-6.3	-5.3	-6.3	-6.9	-6.5	-5.8	-4.5
\$END												

9 Example Output Files

9.1 RST-formatted Spectra Output (RST File)

Following is a single partition from an RST-formatted Spectra Output (RST File):

```
* Process History
* Executed at 17:55:33 on 10/04/2000 By: whh8673
* From directory: C:\Task10\program_checkout
*
* MCP Input File:
* c:\Task10\program_checkout\example_input.txt
* RST Output File:
* c:\Task10\program_checkout\example_output.rst.txt
* Delta File: (No delta file was provided.)
*
*
* END DOC.

$BEGIN IB31950_INLET3_BROADBAND
$TITLE
INLET3_BROADBAND
Modular Engine Noise Component Prediction System
Example Run with No Deltas
First Condition
(up to four lines of title information allowed)
*
$SCALARS
ALTEVO      SL      VTAS      FPA      PAE      HMIC      RNENG      TCBMIN      TCFLR      FLAPA
18.    -150.      0.0      0.0      0.0      0.0      1.      17.      30.0      0.
*
XN1R1      FNR      XN1      TFCOR      RHCOR      RHMEA      TFMEA      PSIMEA      WNDREN      WNDKTS      NBAND
1950.      0.    2000.      77.0      70.0      70.0      77.0      14.70      0.0      0.0      24
*
XMTIP      XMFF      RLINL      FHTR      FBLNO      FANDIA      FEGV      FCHORD      FTIPCH
0.750      0.250      5.000      0.375      36.      90.00      78.00      10.000      4.00
*
P12      T1      RMEAN      RSIGMA
14.68      536.5      -0.2860      0.5730
*
$ARRAYS
IBAND(NBAND)
17      18      19      20      21      22      23      24      25      26      27      28
29      30      31      32      33      34      35      36      37      38      39      40

FREQ(NBAND)
50.      63.      80.      100.      125.      160.      200.      250.      315.      400.
500.      630.      800.      1000.      1250.      1600.      2000.      2500.      3150.      4000.
5000.      6300.      8000.      10000.

$TABLE
EMANG TIMRVO DOPANG SPDIST
SPL(NBAND)
PNL      PNLT      DBA      OASPL      DBD      TCB      RMXNYB
$VALUES
10.0      0.00      10.0      151.1
63.6      64.9      66.1      67.1      68.0      68.9      69.9      71.0      72.1      73.3      74.7      76.0
77.4      78.8      80.2      81.5      82.6      83.6      84.4      85.0      85.4      85.5      85.3      84.9
107.81      107.81      94.71      94.61      0.00      0.      36.

20.0      0.00      20.0      151.1
64.4      65.8      66.9      67.9      68.8      69.8      70.7      71.8      72.9      74.2      75.5      76.9
78.3      79.6      81.0      82.3      83.4      84.5      85.3      85.9      86.2      86.3      86.1      85.7
108.64      108.64      95.54      95.44      0.00      0.      36.

30.0      0.00      30.0      151.1
64.9      66.3      67.4      68.4      69.4      70.3      71.3      72.3      73.5      74.7      76.0      77.4
78.8      80.2      81.5      82.8      84.0      85.0      85.8      86.4      86.8      86.9      86.7      86.2
109.18      109.18      96.08      95.98      0.00      0.      36.

40.0      0.00      40.0      151.1
64.8      66.2      67.3      68.3      69.2      70.2      71.2      72.2      73.3      74.6      75.9      77.3
```


	78.7	80.0	81.4	82.7	83.8	84.9	85.7	86.3	86.6	86.7	86.5	86.1
	109.04	109.04	95.94	95.84	0.00	0.	36.					
50.0	0.00	50.0	151.1									
	64.0	65.4	66.5	67.5	68.5	69.4	70.4	71.4	72.6	73.8	75.1	76.5
	77.9	79.3	80.6	81.9	83.1	84.1	84.9	85.5	85.9	85.9	85.8	85.3
	108.27	108.27	95.17	95.07	0.00	0.	36.					
60.0	0.00	60.0	151.1									
	62.7	64.0	65.2	66.2	67.1	68.0	69.0	70.1	71.2	72.5	73.8	75.1
	76.5	77.9	79.3	80.6	81.7	82.7	83.5	84.1	84.5	84.6	84.4	84.0
	106.91	106.91	93.82	93.71	0.00	0.	36.					
70.0	0.00	70.0	151.1									
	60.8	62.1	63.3	64.3	65.2	66.1	67.1	68.2	69.3	70.6	71.9	73.2
	74.6	76.0	77.4	78.7	79.8	80.8	81.6	82.2	82.6	82.7	82.5	82.1
	105.01	105.01	91.92	91.82	0.00	0.	36.					
80.0	0.00	80.0	151.1									
	58.4	59.8	60.9	61.9	62.8	63.8	64.7	65.8	66.9	68.2	69.5	70.9
	72.2	73.6	75.0	76.3	77.4	78.5	79.3	79.9	80.2	80.3	80.1	79.7
	102.62	102.62	89.54	89.44	0.00	0.	36.					
90.0	0.00	90.0	151.1									
	55.6	56.9	58.1	59.1	60.0	60.9	61.9	63.0	64.1	65.4	66.7	68.0
	69.4	70.8	72.2	73.5	74.6	75.6	76.4	77.0	77.4	77.5	77.3	76.9
	99.79	99.79	86.72	86.62	0.00	0.	36.					
100.0	0.00	100.0	151.1									
	52.4	53.7	54.9	55.9	56.8	57.7	58.7	59.8	60.9	62.1	63.5	64.8
	66.2	67.6	69.0	70.2	71.4	72.4	73.2	73.8	74.2	74.3	74.1	73.7
	96.57	96.57	83.51	83.40	0.00	0.	36.					
110.0	0.00	110.0	151.1									
	48.8	50.2	51.3	52.3	53.2	54.2	55.2	56.2	57.4	58.6	59.9	61.3
	62.7	64.1	65.4	66.7	67.9	68.9	69.7	70.3	70.6	70.7	70.6	70.1
	93.00	93.00	79.96	79.85	0.00	0.	36.					
120.0	0.00	120.0	151.1									
	45.0	46.3	47.5	48.5	49.4	50.3	51.3	52.4	53.5	54.7	56.1	57.4
	58.8	60.2	61.6	62.8	64.0	65.0	65.8	66.4	66.8	66.9	66.7	66.3
	89.14	89.14	76.11	76.00	0.00	0.	36.					
130.0	0.00	130.0	151.1									
	40.9	42.2	43.4	44.4	45.3	46.2	47.2	48.3	49.4	50.7	52.0	53.3
	54.7	56.1	57.5	58.8	59.9	60.9	61.7	62.3	62.7	62.8	62.6	62.2
	85.02	85.02	72.02	71.91	0.00	0.	36.					
140.0	0.00	140.0	151.1									
	36.6	38.0	39.1	40.1	41.0	42.0	42.9	44.0	45.1	46.4	47.7	49.0
	50.4	51.8	53.2	54.5	55.6	56.6	57.5	58.1	58.4	58.5	58.3	57.9
	80.70	80.70	67.73	67.62	0.00	0.	36.					
150.0	0.00	150.0	151.1									
	32.1	33.5	34.7	35.6	36.6	37.5	38.5	39.6	40.7	41.9	43.2	44.6
	46.0	47.4	48.8	50.0	51.2	52.2	53.0	53.6	54.0	54.1	53.9	53.5
	76.23	76.23	63.29	63.19	0.00	0.	36.					
160.0	0.00	160.0	151.1									
	27.6	29.0	30.1	31.1	32.0	33.0	34.0	35.0	36.2	37.4	38.7	40.1
	41.5	42.9	44.2	45.5	46.7	47.7	48.5	49.1	49.4	49.5	49.4	48.9
	71.61	71.61	58.76	58.65	0.00	0.	36.					
170.0	0.00	170.0	151.1									
	23.0	24.4	25.6	26.6	27.5	28.4	29.4	30.5	31.6	32.8	34.1	35.5
	36.9	38.3	39.7	40.9	42.1	43.1	43.9	44.5	44.9	45.0	44.8	44.4
	66.88	66.88	54.19	54.09	0.00	0.	36.					
\$TABLE												
PN2DVAR*8 PNROWSFX*8 PNCOLSFX*8 PRFXROW*18 PRFXCOL*18												
\$VALUES												
'SPL' 'EMANG' 'IBAND' 'SPL@ANG_' 'SPL@BAND_'												

\$END

9.2 Tabular Spectra Output (Report File)

(Due to the large number of columns used in this file, no example is presented here.)

9.3 Noise Metric Output (Summary File)

```
$BEGIN      18.1950_SUMMARY
$TITLE
TOTAL_(STATIC)
Modular Engine Noise Component Prediction System
Example Run with No Deltas
First Condition
(up to four lines of title information allowed)
$SCALARS
  ALTEVO    SL      VTAS    FPA    PAE    HMIC    RNENG    TCBMIN    TCFLR
    18.   -150.      0.0    0.0    0.0    0.0      1.     17.     30.0
$TABLE
  ID*3      XN1R1    OASPL    DBA      DBD      PNL      PNLT      FNR
$VALUES
  'IN3'    1950.0    96.68    96.92    0.00    109.96    111.52      0.
  'AF7'    1950.0    90.72    91.41    0.00    102.92    108.06      0.
  'J6E'    1950.0    89.28    78.33    0.00    91.13     91.13      0.
  'TOT'    1950.0    96.89    96.94    0.00    110.31    111.85      0.

$END
$BEGIN      18.2450_SUMMARY
$TITLE
TOTAL_(STATIC)
Modular Engine Noise Component Prediction System
Example Run with No Deltas
Second Condition
(up to four lines of title information allowed)
$SCALARS
  ALTEVO    SL      VTAS    FPA    PAE    HMIC    RNENG    TCBMIN    TCFLR
    18.   -150.      0.0    0.0    0.0    0.0      1.     17.     30.0
$TABLE
  ID*3      XN1R1    OASPL    DBA      DBD      PNL      PNLT      FNR
$VALUES
  'IN3'    2450.0    99.83    100.16    0.00    113.18    115.86      0.
  'AF7'    2450.0    99.56    100.33    0.00    112.55    119.22      0.
  'J6E'    2450.0    96.92    84.50    0.00    98.02     98.02      0.
  'TOT'    2450.0    100.66    100.47    0.00    114.59    120.42      0.

$END
$BEGIN      18.2950_SUMMARY
$TITLE
TOTAL_(STATIC)
Modular Engine Noise Component Prediction System
Example Run with No Deltas
Third Condition
(up to four lines of title information allowed)
$SCALARS
  ALTEVO    SL      VTAS    FPA    PAE    HMIC    RNENG    TCBMIN    TCFLR
    18.   -150.      0.0    0.0    0.0    0.0      1.     17.     30.0
$TABLE
  ID*3      XN1R1    OASPL    DBA      DBD      PNL      PNLT      FNR
$VALUES
  'IN3'    2950.0    102.44    103.00    0.00    115.95    121.01      0.
  'AF7'    2950.0    103.83    104.58    0.00    115.47    122.13      0.
  'J6E'    2950.0    105.05    91.41    0.00    105.38    105.38      0.
  'TOT'    2950.0    105.52    104.78    0.00    118.47    125.13      0.

$END
```

10 References

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2. Lu, H. Y., "An Empirical Model for Prediction of Coaxial Jet Noise in Ambient Flow," AIAA 86-1912, 10th Aeroacoustics Conference, July 1986.
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4. Tanna, H. K., "Prediction Method for Shock-Associated Noise from Convergent Nozzles at Supercritical Conditions," proposal to SAE A21 Jet Exhaust Noise Subcommittee, July 19, 1977.

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14. ABSTRACT This is a user's manual for Modular Engine Noise Component Prediction System (MCP). This computer code allows the user to predict turbofan engine noise estimates. The program is based on an empirical procedure that has evolved over many years at The Boeing Company. The data used to develop the procedure include both full-scale engine data and small-scale model data, and include testing done by Boeing, by the engine manufacturers, and by NASA. In order to generate a noise estimate, the user specifies the appropriate engine properties (including both geometry and performance parameters), the microphone locations, the atmospheric conditions, and certain data processing options. The version of the program described here allows the user to predict three components: inlet-radiated fan noise, aft-radiated fan noise, and jet noise. MCP predicts one-third octave band noise levels over the frequency range of 50 to 10,000 Hertz. It also calculates overall sound pressure levels and certain subjective noise metrics (e.g., perceived noise levels).						
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